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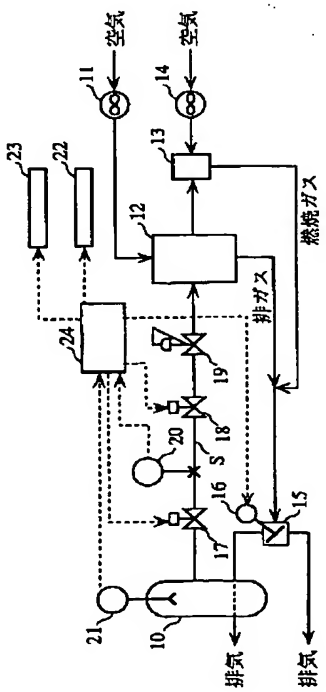
最終頁に続く

(54)【発明の名称】　燃料電池および燃料電池の故障診断方法

(57)【要約】

【目的】　燃料ガス供給源と燃料電池本体を連通する燃料ガス供給配管に設けた開閉弁の故障診断を、非常に簡単な構成で行うことができる燃料電池および燃料電池の故障診断方法を提供すること。

【構成】　起動時に、第１の開閉弁１７と第２の開閉弁１８とが閉弁された状態で、水素ガス圧センサー２０が検出するガス圧から、第１の開閉弁１７の故障診断を行い、つづいて、第１の開閉弁１７を所定時間開弁した後、閉弁し、閉弁から所定時間経過に、水素ガス圧センサー２０が検出するガス圧から、第２の開閉弁１７の故障診断を行う。



1

【特許請求の範囲】
【請求項１】　燃料ガスと酸化剤ガスの供給を受けて電気化学的な反応により発電を行う燃料電池本体と、
燃料ガス供給源からの燃料ガスを前記燃料電池本体へ導く燃料ガス供給配管と、
前記燃料ガス供給配管に挿設された第１の開閉弁と、
前記燃料ガス供給配管に、燃料ガスの流れに対して、第１の開閉弁より下流側に挿設された第２の開閉弁と、
第１の開閉弁と第２の開閉弁との間に設けられ、その間の前記燃料ガス供給配管に存する燃料ガスの圧力を検出する圧力センサーと、
を備えていることを特徴とする燃料電池。
【請求項２】　前記燃料ガス供給源は燃料タンクからなり、前記圧力センサーは、前記燃料タンクのガス圧の制御と燃料の残量検知を行うための圧力センサーを兼用することを特徴とする請求項１記載の燃料電池。
【請求項３】　起動時に、
前記第１、２の開閉弁が閉弁された状態において、前記圧力センサーの検出値から、第１の開閉弁の故障判定をおこない、
つづいて、第１の開閉弁が開弁された後、閉弁された状態において、閉弁から所定時間経過後に前記圧力センサーの検出値から、第２の開閉弁の故障判定をおこなう故障診断部を備えたことを特徴とする請求項１または２記載の燃料電池。
【請求項４】　燃料ガス供給源から燃料電池本体へ燃料ガスを供給する配管に、第１の開閉弁と燃料ガスの流れに対して第１の開閉弁よりも下流側に第２の開閉弁とを挿設し、第１の開閉弁と第２の開閉弁との間に、その間の前記配管に存する燃料ガスの圧力を検出する圧力センサーを設けた燃料電池において、
起動時に、
第１、２の開閉弁を閉弁した状態で、前記圧力センサーが検出する検出値から、第１の開閉弁の故障診断をおこなうステップと、
つづいて、第１の開閉弁を開弁した後、閉弁し、閉弁から所定時間経過後に前記圧力センサーが検出する検出値から、第２の開閉弁の故障診断をおこなうステップと、
を有することを特徴とする燃料電池の故障診断方法。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】本発明は、燃料ガス供給源と電池本体の間の燃料ガス供給配管に開閉弁を備える燃料電池およびその故障診断方法に関する。
【０００２】
【従来の技術】燃料電池において、運転停止時は燃料電池本体へ燃料ガスを供給する必要はないので、燃料ガス供給源と燃料電池本体の間の燃料ガス供給配管に開閉弁を設け、燃料ガスの供給を停止させ、かつ、燃料ガスが燃料電池外部へ漏れないようにしている。

2

【０００３】ところが、一般に燃料ガスは水素リッチな可燃性のガスなので、より安全を確保することが要請され、そのため開閉弁の数を増やすことと開閉弁の速やかな故障検出を行うこととが必要とされている。
【０００４】
【発明が解決しようとする課題】しかし、開閉弁の数を増やし、夫々の開閉弁についての故障診断を行うには、故障診断のための部品が別途必要となり、構成の複雑化、コストアップといった構成面での不利益を招くものである。本発明は、上記背景に鑑み、非常に簡便な構成で、燃料ガス供給源と燃料電池本体の間に設けた２個の開閉弁の故障診断をおこなうことが可能な燃料電池および燃料電池の故障診断方法を提供することを目的とする。
【０００５】
【課題を解決するための手段】上記の目的を達成するため、請求項１記載の燃料電池は、燃料ガスと酸化剤ガスの供給を受けて電気化学的な反応により発電を行う燃料電池本体と、燃料ガス供給源からの燃料ガスを前記燃料電池本体へ導く燃料ガス供給配管と、前記燃料ガス供給配管に挿設された第１の開閉弁と、前記燃料ガス供給配管に、燃料ガスの流れに対して、第１の開閉弁より下流側に挿設された第２の開閉弁と、第１の開閉弁と第２の開閉弁との間に設けられ、その間の前記燃料ガス供給配管に存する燃料ガスの圧力を検出する圧力センサーとを備えたことを特徴としている。
【０００６】また、請求項２記載の燃料電池は、請求項１記載の燃料電池に対して、燃料ガス供給源は燃料タンクからなり、圧力センサーは、前記燃料タンクのガス圧の制御と燃料の残量検知を行うための圧力センサーを兼用することをことを特徴としている。また、請求項３記載の燃料電池は、請求項１または２記載の燃料電池に対して、起動時に、第１、２の開閉弁が閉弁された状態において、圧力センサーの検出値から、第１の開閉弁の故障判定をおこない、つづいて、第１の開閉弁が開弁された後、閉弁された状態において、閉弁から所定時間経過後に前記圧力センサーの検出値から、第２の開閉弁の故障判定をおこなう故障診断部を備えたことを特徴としている。
【０００７】また、請求項４記載の燃料電池の故障診断方法は、燃料ガス供給源から燃料電池本体へ燃料ガスを供給する配管に、第１の開閉弁と燃料ガスの流れに対して第１の開閉弁よりも下流側に第２の開閉弁とを挿設し、第１の開閉弁と第２の開閉弁との間に、その間の前記配管に存する燃料ガスの圧力を検出する圧力センサーを設けた燃料電池において、起動時に、第１、２の開閉弁を閉弁した状態で、前記圧力センサーが検出する検出値から、第１の開閉弁の故障診断をおこなうステップと、つづいて、第１の開閉弁を開弁した後、閉弁し、閉弁から所定時間経過後に前記圧力センサーが検出する検

出値から、第２の開閉弁の故障診断をおこなうステップとを有することを特徴としている。

【０００８】

【作用】請求項１記載の燃料電池によれば、起動時に、第１、２の開閉弁を閉弁した状態で、その間の燃料ガス供給配管内に存する燃料ガスの圧力を圧力センサーで検出することにより、第１の開閉弁の故障判定が行え、第１の開閉弁を所定時間開弁した後閉弁し、閉弁から所定時間経過後に前記圧力センサーで同燃料ガスの圧力を検出することにより、第２の開閉弁の故障判定が行える。

【０００９】請求項２記載の燃料電池によれば、起動時には、圧力センサーにより、請求項１記載の燃料電池と同様の作用が得られ、運転時には、同じセンサーが用いられて、燃料タンクのガス圧の制御と燃料の残量検知が行われる。請求項３記載の燃料電池によれば、起動時に、故障診断部が、第１、２の開閉弁が閉弁された状態で、その間の燃料ガス供給配管内に存する燃料ガスの圧力を検出する圧力センサーの検出値から、第１の開閉弁の故障判定を行い、つづいて、第１の開閉弁が開弁された後、閉弁された状態において、閉弁から所定時間経過後の前記圧力センサーの検出値から、第２の開閉弁の故障判定を行う。

【００１０】請求項４記載の燃料電池の故障診断方法によれば、起動時に、第１、２の開閉弁を閉弁した状態で、その間の配管内に存する燃料ガスの圧力を圧力センサーで検出することにより、第１の開閉弁の故障診断を行い、つづいて、第１開閉弁を開弁した後閉弁し、閉弁から所定時間経過後に前記圧力センサーで同燃料ガスの圧力を検出することにより、第２開閉弁の故障診断を行う。

【００１１】

【実施例】以下、本発明の実施例について、図面を参照しながら具体的に説明する。図１は、本発明の一実施例に係る燃料電池の概略構成図である。図に示すように、本燃料電池は、主として、水素吸蔵合金が充填されている燃料タンク１０と、水素と空気の供給を受けて電気化学的な反応により発電を行う燃料電池本体１２と、燃料電池を安全に効率良く運転すること等を目的とする制御（制御内容については後に詳述する）を行う制御部２４とから構成されており、前記燃料タンク１０と前記燃料電池本体１２とは、燃料タンク１０から燃料電池本体１２へ水素を供給するための水素供給配管Ｓで接続されている。

【００１２】そして、空気供給ファン１１は、燃料電池本体１２へ空気を供給するためのものであり、供給され燃料電池本体１２で発電に供された空気は排ガスとなって、ダンパ１５に導かれる。また、触媒燃焼器１３は、燃料電池本体１２から排出される未反応の水素ガスを処理するものであり、処理された水素ガスは燃焼ガスとなって排出され前記排ガスと合流して、ダンパ１５に導かれる。そして、ダンパ１５は、導かれた排ガスと燃焼ガスの流路調節をするものであり、ダンパ駆動モータ１６で回動される。

【００１３】また、前記水素供給配管Ｓには、水素の流れに対して上流側から順に、開閉により水素の給止を行う第１開閉弁１７と同じく開閉により水素の給止を行う第２開閉弁１８と燃料電池本体１２内での水素の内圧を一定に保つように作動する圧力調整弁１９とが挿設されている。さらに、前記燃料タンク１０には、当該タンク内の温度を検出する温度センサー２１が、第１開閉弁１７と第２開閉弁１８との間の前記水素供給配管Ｓには、第１開閉弁１７と第２開閉弁１８の間に存する配管Ｓ内の水素ガスの圧力を検出する水素ガス圧センサー２０が設けられている。

【００１４】そして、前記燃料タンク１０内の水素残量の表示を行う残量表示計２２と、第１開閉弁故障ランプ、第２開閉弁故障ランプ、ＯＫランプの３個のランプ（図示せず）を備えた故障表示装置２３とが制御部２４に接続されている。なお、水素ガス圧センサー２０は、第１開閉弁が開かれた状態では、実質的に燃料タンク１０内の水素ガスの圧力を検出していることになる。

【００１５】上記のように構成された本燃料電池の制御部２４における動作について、１．燃料タンク１０内の水素残量の演算、２．ダンパーの回動制御、３．第１、２開閉弁の故障診断に分けて説明する。

（１．燃料タンク１０内の水素残量の演算）燃料タンク１０内の水素残量は、水素ガス圧センサー２０が検出するガス圧情報と温度センサー２１が検出する温度情報とから水素吸蔵合金のＰＣＴ特性に基づいて演算される。

【００１６】ＰＣＴ特性とは、水素吸蔵合金において、水素ガスの圧力と温度と水素吸蔵量の間に一定の関係がある性質であり、水素吸蔵時と放出時で若干の差が生じるが、本実施例で用いるのは、図２に示す放出時のＰＣＴ特性である。なお、このＰＣＴ特性は予め制御部２４に記憶されている。制御部２４は、水素ガス圧センサー２０が検出するガス圧情報と温度センサー２１が検出する温度情報とから予め記憶されている水素吸蔵合金のＰＣＴ特性に基づいて、燃料タンク１０内の水素ガスの量を演算し、その結果を残量表示計２２へ出力する。そして、燃料タンク１０内の水素ガスの量の情報をうけとった残量表示計２２は、その情報に応じた燃料タンク１０内の水素ガスの残量を表示する。

（２．ダンパーの回動制御）ダンパーの回動制御は、水素ガス圧センサー２０が検出するガス圧情報に基づいて行われる。

【００１７】制御部２４は、水素ガス圧センサー２０が検出する燃料タンク内の水素ガスの圧力が、予め定められている所定の圧力Ｐｄ１より小さくなると、ダンパー駆動モータ１６の駆動によってダンパー１５を回動させ、燃料電池本体１２からでる排ガスと触媒燃焼器１３

からでる燃焼ガスを燃料タンク１０の周囲へ導き、その中に充填されている水素吸蔵合金を温めることによって、水素ガスの放出量を増やし、一方、水素ガス圧センサー２０が検出する燃料タンク内の水素ガスの圧力が、予め定められている所定の圧力Ｐｄ２より大きくなると、ダンパー駆動モータ１６の駆動によってダンパー１５を回動させ、燃料電池本体１２からでる排ガスと触媒燃焼器１３からでる燃焼ガスを燃料タンク１０の周囲へ導くことなく排出する。ここで、Ｐｄ１、Ｐｄ２は、発電に要する十分な量の水素を燃料電池本体へ安定して送出することができるような圧力に設定され、Ｐｄ１とＰｄ２の大小関係は、Ｐｄ１＜Ｐｄ２である。以上の制御により、燃料タンク１０内の水素ガス圧力がほぼＰｄ１～Ｐｄ２の間に保たれた状態で、本燃料電池は運転されることになる。

（３．第１、２開閉弁の故障診断）第１、２開閉弁の故障診断は、水素ガス圧センサー２０が検出するガス圧情報を利用して行われる。

【００１８】本燃料電池起動時に制御部２４が行う第１、２開閉弁の故障診断の動作を、図３に示すフローチャートに基づいて説明する。本燃料電池起動時には、第１、２開閉弁は、共に閉弁されており、この状態で、制御部２４は、水素ガス圧センサー２０が検出する水素ガス圧Ｐを読み込む（ステップＳ１０）。読み込んだ水素ガス圧Ｐと予め設定しておいた圧力Ｐｍ１とを比較し（ステップＳ１１）、ＰがＰｍ１以上の場合は、故障表示装置２３の第１開閉弁故障ランプを点灯させて（ステップＳ１２）処理を終了する。ここで、圧力Ｐｍ１は、後述するステップＳ１６の処理で用いる圧力Ｐｍ２よりやや低めの所定の値に設定されている。なお、圧力Ｐｍ２は、常温における燃料タンク１０内の水素ガス圧力と略等しい値に設定されている。したがって、本燃料電池起動時に、第１開閉弁を閉弁した状態で検出した、配管Ｓ内の第１開閉弁１７に対して燃料タンク１０の反対側の圧力Ｐが、燃料タンク１０内の水素ガス圧よりやや低めに設定した圧力Ｐｍ１以上の値を示した場合には、第１開閉弁１７に「漏れ」が発生しているということになるので、上記の方法で第１開閉弁１７の故障診断を行うことができるのである。

【００１９】一方、ステップＳ１１で、検出圧力Ｐが設定圧力Ｐｍ１より低かった場合は、処理はステップＳ１３に進み、第１開閉弁１７を一旦開弁し、２秒後に再び閉弁し（ステップＳ１４）、閉弁から５秒経過後に、水素ガス圧センサー２０が検出する水素ガス圧Ｐを読み込む（ステップＳ１５）。読み込んだ水素ガス圧Ｐと予め設定しておいた前記圧力Ｐｍ２とを比較し（ステップＳ１６）、ＰがＰｍ２以下の場合は、故障表示装置２３の第２開閉弁故障ランプを点灯させて（ステップＳ１７）処理を終了する。つまり、第２開閉弁１８を閉弁したままで、第１開閉弁１７を一旦開弁することにより、配管Ｓ内の両開閉弁間の圧力を燃料タンク１０内の圧力と略同等までに高め、再び第１開閉弁１７を閉弁してから５秒経過後に検出される圧力Ｐが、燃料タンク内の圧力と略同等の値に設定されている圧力Ｐｍ２より低い値を示した場合には、第２開閉弁１８に「漏れ」が発生しているということになるので、上記の方法で第２開閉弁１８の故障診断を行うことができるのである。なお、第１開閉弁１７の開弁時間を２秒としたのは、それが、配管Ｓ内の両開閉弁間の圧力を燃料タンク１０内の圧力と略同等までに高めるのに十分な時間であり、それ以上では、徒に時間を無駄にすることとなり、それ以下では、配管Ｓ内の両開閉弁間の圧力を燃料タンク１０内の圧力と略同等までに高められない虞があるからである。また、第１開閉弁１７の閉弁から圧力検出までの時間を５秒としたのは、第２開閉弁に「漏れ」故障が発生していた場合に、配管Ｓ内の両開閉弁間の圧力低下を生じるのに十分な時間であり、それ以上では、徒に時間を無駄にすることとなり、それ以下では、故障検出ができる程に十分な圧力低下が得られない虞があるからである。

【００２０】そして、ステップＳ１６で、検出圧力Ｐが設定圧力Ｐｍ２以上であった場合は、処理はステップＳ１８に進み、故障表示装置２３のＯＫランプを点灯させて処理を終了する。なお、本実施例で用いた、第１開閉弁の開弁時間（２秒）や第１開閉弁閉弁後圧力検出するまでの時間（５秒）や水素吸蔵合金のＰＣＴ特性等は、燃料電池の仕様や水素吸蔵合金の種類に応じて適宜変更されるものである。

【００２１】また、本実施例では、燃料ガス供給源として、水素吸蔵合金が充填されている燃料タンクを用いたが、これに限定されるものではなく、例えば、既設の天然ガスや都市ガス等を用いてもよい。

【００２２】

【発明の効果】以上、請求項１記載の発明に係る燃料電池によれば、燃料ガス供給源と燃料電池本体の間の燃料供給配管に設けた第１、２の開閉弁の故障判定が、前記開閉弁の間に、前記燃料供給配管に存する燃料ガスの圧力を検出する圧力センサーを設けただけのすこぶる簡便な構成で行え、かつ、同センサーで燃料ガス供給源の燃料ガスの圧力を検出することができるといった効果を有する。

【００２３】また、請求項２記載の発明に係る燃料電池によれば、第１、２の開閉弁の故障判定の為の圧力センサーは、燃料タンクのガス圧の制御と燃料の残量検知を行うための圧力センサーを兼用するので、請求項１記載の燃料電池の効果に加えて、部品の共有化によるコストダウンが得られると言った効果を有する。また、請求項３記載の発明に係る燃料電池によれば、起動時に、故障診断部が、第１、２開閉弁が閉弁された状態において、圧力センサーの検出値から、第１の開閉弁の故障判定を行い、つづいて、第１開閉弁を開弁した後閉弁し、閉弁

から所定時間経過後の前記圧力センサーの検出値から、第２の開閉弁の故障診断を行うので、請求項１または２記載の燃料電池と同様な効果を有する。

【００２４】また、請求項４記載の発明に係る燃料電池の故障診断方法によれば、燃料ガス供給源と燃料電池本体の間の燃料ガス供給配管に設けた第１、２の開閉弁の故障診断が、起動時に、第１、２開閉弁を閉弁した状態で、その間の配管内に存する燃料ガスの圧力を圧力センサーで検出し、つづいて、第１開閉弁を開弁した後閉弁し、閉弁から所定時間経過後に前記圧力センサーで同燃料ガスの圧力を検出することにより行うといったすこぶる簡便な方法によって実施することができるといった効果を有する。

【図面の簡単な説明】

【図１】本発明の一実施例に係る燃料電池の概略構成を示す図である。

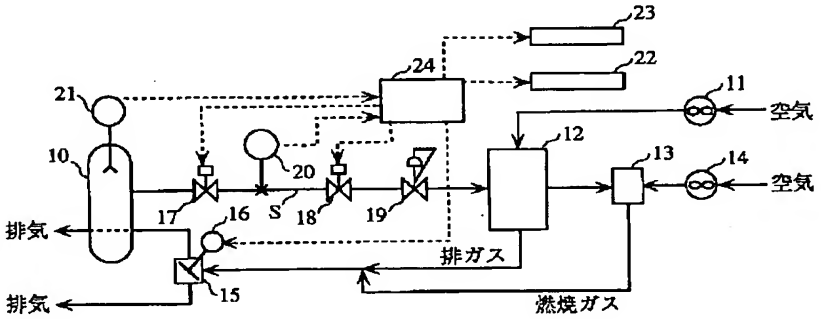
【図２】上記実施例における水素吸蔵合金のＰＣＴ特性を示す図である。

【図３】上記実施例における制御部２４の一処理手順を示すフローチャートである。

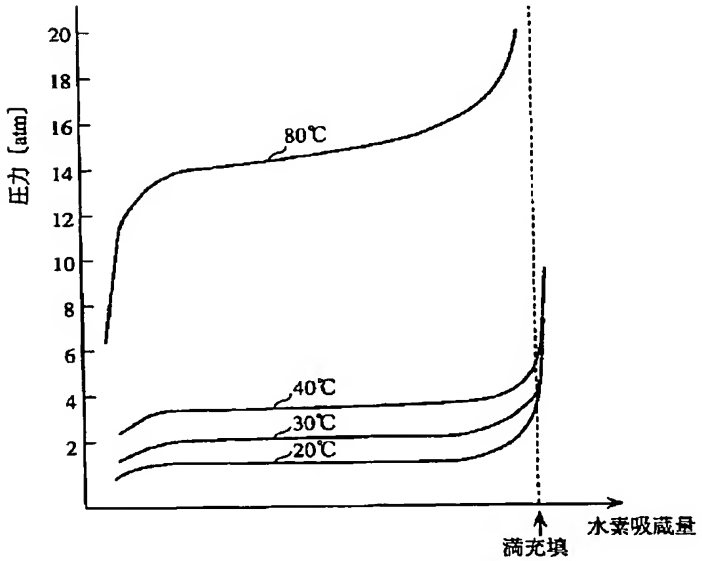
【符号の説明】

１０　燃料タンク
１２　燃料電池本体
１７　第１開閉弁
１８　第２開閉弁
２０　水素ガス圧センサー
２４　制御部
Ｓ　水素供給配管

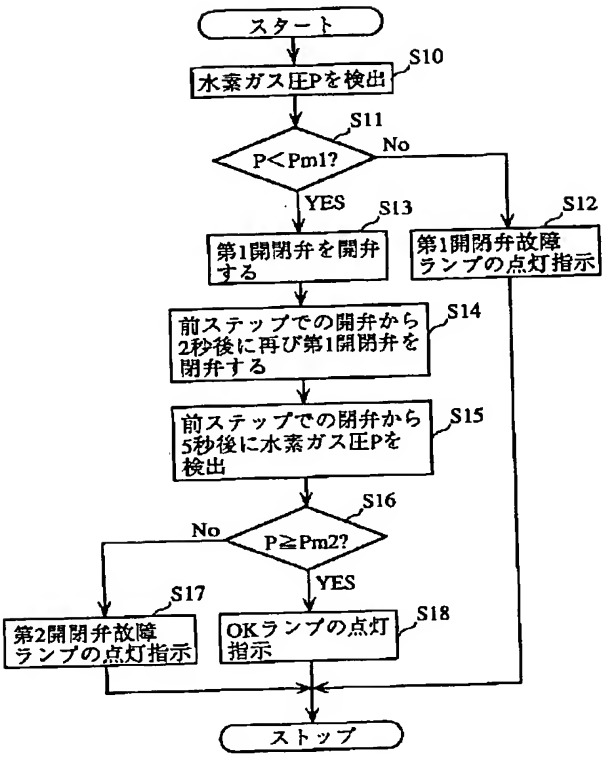
【図１】



【図２】



【図３】



フロントページの続き

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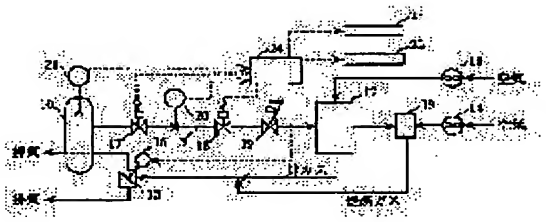
(54) FUEL CELL AND TROUBLE DIAGNOSING METHOD FOR IT

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a fuel cell of a very simple configuration and establish a trouble diagnosing method for fuel cell by performing failure diagnosis of an opening/closing valve furnished in a fuel gas supply piping leading from a fuel gas supply source to the body of fuel cell.
SOLUTION: At starting, failure diagnosis of a first opening/closing valve 17 is conducted from the gas pressure sensed by a hydrogen gas pressure sensor 20 in the condition that the first 17 and a second opening/closing valve 18 are closed. The first opening/closing valve 17 is closed after leaving it open for a certain period of time, and when a specified time has elapsed after the valve is closed, the failure diagnosis of the second opening/closing valve 17 is conducted with the gas pressure sensed by the sensor 20.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to a fuel cell which equips the fuel gas charging line between a fuel gas supply source and a cell proper with an opening and closing valve, and a fault diagnosis method for the same.
[0002]
[Description of the Prior Art]Since it is not necessary to supply fuel gas to a fuel cell body at the time of shutdown, an opening and closing valve is provided in the fuel gas charging line between a fuel gas supply source and a fuel cell body, and supply of fuel gas is stopped, and fuel gas is kept from leaking to the fuel cell exterior in a fuel cell.
[0003]however — general — fuel gas — hydrogen — since it is rich inflammable gas, that it is requested that safety should be ensured more, therefore it increases the number of opening and closing valves and to perform failure detection with a prompt opening and closing valve are needed.
[0004]
[Problem(s) to be Solved by the Invention]However, in order to increase the number of opening and closing valves and to perform failure diagnosis about each opening and closing valve, the parts for failure diagnosis are needed separately, and complication of composition and the disadvantage in the constituent face of a cost hike are caused. In view of the above-mentioned background, this invention is very simple composition and an object of this invention is to provide the fault diagnosis method of the fuel cell which can perform failure diagnosis of two opening and closing valves provided between the fuel gas supply source and the fuel cell body, and a fuel cell.
[0005]
[Means for Solving the Problem]This invention is characterized by the fuel cell according to claim 1 comprising the following, in order to attain the above-mentioned purpose.
A fuel cell body which generates electricity by an electrochemical reaction in response to supply of fuel gas and oxidant gas.
A fuel gas charging line which leads fuel gas from a fuel gas supply source to said fuel cell body.
The 1st opening and closing valve inserted in said fuel gas charging line.
A pressure sensor which detects a pressure of fuel gas which is formed between the 2nd opening and closing valve inserted in said fuel gas charging line from the 1st opening and closing valve to a flow of fuel gas at the downstream, and the 1st opening and closing valve and the 2nd opening and closing valve, and consists in said fuel gas charging line in the meantime.

[0006]As for the fuel cell according to claim 2, a fuel gas supply source consists of fuel tanks to the fuel cell according to claim 1, and a pressure sensor is characterized for making a pressure sensor for performing control of gas pressure of said fuel tank, and detect residual quantity of fuel serve a double purpose by things. In the state where the 1st and 2 opening and closing valve was closed to the fuel cell according to claim 1 or 2 at the time of starting as for the fuel cell according to claim 3, After performing failure determination of the 1st opening and closing valve, continuing and opening the 1st opening and closing valve from a detection value of a pressure sensor, in the state where the valve was closed, it is characterized by having a failure diagnosis part which performs failure determination of the 2nd opening

and closing valve from a detection value of said pressure sensor after specified time elapse from valve closing.
[0007]This invention a fault diagnosis method of the fuel cell according to claim 4, From a fuel gas supply source, for piping which supplies fuel gas, insert the 2nd opening and closing valve in the downstream to a flow of the 1st opening and closing valve and fuel gas, and rather than the 1st opening and closing valve to a fuel cell body between the 1st opening and closing valve and the 2nd opening and closing valve, A fuel cell which formed a pressure sensor which detects a pressure of fuel gas which consists in said piping in the meantime is characterized by comprising:
A step which performs failure diagnosis of the 1st opening and closing valve from a detection value which said pressure sensor detects at the time of starting where the 1st and 2 opening and closing valve is closed.
A step which performs failure diagnosis of the 2nd opening and closing valve from a detection value which is closed after continuing and opening the 1st opening and closing valve, and said pressure sensor detects from valve closing after specified time elapse.

[0008]
[Function]According to the fuel cell according to claim 1, at the time of starting, where the 1st and 2 opening and closing valve is closed, By detecting the pressure of the fuel gas which consists in a fuel gas charging line in the meantime with a pressure sensor, Failure determination of the 1st opening and closing valve can be performed, and failure determination of the 2nd opening and closing valve can be performed by closing the valve, after carrying out predetermined time valve opening of the 1st opening and closing valve, and detecting the pressure of the fuel gas from valve closing with said pressure sensor after specified time elapse.
[0009]According to the fuel cell according to claim 2, at the time of starting, the same operation as the fuel cell according to claim 1 is obtained by a pressure sensor, the same sensor is used at the time of operation, and control of the gas pressure of a fuel tank and detect residual quantity of fuel are performed.
According to the fuel cell according to claim 3, at the time of starting, where the 1st and 2 opening and closing valve is closed, a failure diagnosis part, In the state where the valve was closed after performing failure determination of the 1st opening and closing valve, continuing and opening the 1st opening and closing valve from the detection value of the pressure sensor which detects the pressure of the fuel gas which consists in a fuel gas charging line in the meantime, Failure determination of the detection value of said pressure sensor after specified time elapse to the 2nd opening and closing valve is performed from valve closing.
[0010]According to the fault diagnosis method of the fuel cell according to claim 4, at the time of starting, where the 1st and 2 opening and closing valve is closed, By detecting the pressure of the fuel gas which consists in piping in the meantime with a pressure sensor, Failure diagnosis of the 2nd opening and closing valve is performed by performing failure diagnosis of the 1st opening and closing valve, continuing, closing the valve, after opening the 1st opening and closing valve, and detecting the pressure of the fuel gas from valve closing with said pressure sensor after specified time elapse.
[0011]
[Example]Hereafter, the example of this invention is described concretely, referring to drawings. Drawing 1 is an outline lineblock diagram of the fuel cell concerning one example of this invention. The fuel tank 10 where this fuel cell is mainly filled up with the hydrogen storing metal alloy as shown in a figure, It comprises hydrogen, the fuel cell body 12 which generates electricity by an electrochemical reaction in response to air supply, and the control section 24 which performs control (a control content is explained in full detail behind) aiming at operating a fuel cell efficiently safely etc.
Said fuel tank 10 and said fuel cell body 12 are connected to the fuel cell body 12 for the hydrogen supply piping S for supplying hydrogen from the fuel tank 10.

[0012]And the air supply fan 11 is for supplying air to the fuel cell body 12.
The supplied air with which power generation was presented with the fuel cell body 12 serves as exhaust gas, and is led to the damper 15.
The catalytic combustion device 13 processes the unreacted hydrogen gas discharged from the fuel cell body 12.

The processed hydrogen gas serves as combustion gas, is discharged, joins said exhaust gas, and is led to the damper 15.
And the damper 15 carries out drawn channel regulation of exhaust gas and combustion gas.
It rotates with the damper drive motor 16.

[0013]The pressure regulating valve 19 which operates so that the internal pressure of hydrogen within the 1st opening and closing valve 17 that performs **** of hydrogen by opening and closing, the 2nd opening and closing valve 18 that similarly performs **** of hydrogen by opening and closing, and the fuel cell body 12 may be kept constant is inserted in said hydrogen supply piping S sequentially from the upstream to the flow of hydrogen. In said fuel tank 10, the temperature sensor 21 to detect the temperature in the tank concerned for said hydrogen supply piping S between the 1st opening and closing valve 17 and the 2nd opening and closing valve 18. The hydrogen-gas-pressure sensor 20 which detects the pressure of hydrogen gas in the piping S which consists between the 1st opening and closing valve 17 and the 2nd opening and closing valve 18 is formed.
[0014]And residual quantity display 22 [a total of] which displays the hydrogen residue in said fuel tank 10, and the trouble indication device 23 provided with three lamps (not shown), the 1st opening and closing valve fault light, the 2nd opening and closing valve fault light, and O.K. lamp, are connected to the control section 24. The hydrogen-gas-pressure sensor 20 will have detected the pressure of hydrogen gas in the fuel tank 10 substantially, where the 1st opening and closing valve is opened.
[0015]It divides into the operation of the hydrogen residue in 1. fuel tank 10, rotation control of 2. damper, and the failure diagnosis of 3. the 1st and 2 opening and closing valve, and the operation in the control section 24 of this fuel cell constituted as mentioned above is explained.
(1. Operation of the hydrogen residue in the fuel tank 10) The hydrogen residue in the fuel tank 10 is calculated based on the PCT characteristic of a hydrogen storing metal alloy from the gas pressure information which the hydrogen-gas-pressure sensor 20 detects, and the temperature information which the temperature sensor 21 detects.
[0016]In a hydrogen storing metal alloy, it is character with the relation fixed between the pressure of hydrogen gas, temperature, and a hydrogen storage capacity to the PCT characteristic, and although it is at the hydrogen absorption and discharge time and some difference arises, it is the PCT characteristic at the time of the discharge shown in drawing 2 which is used by this example. This PCT characteristic is beforehand memorized by the control section 24. Based on the PCT characteristic of the hydrogen storing metal alloy beforehand memorized from the gas pressure information which the hydrogen-gas-pressure sensor 20 detects, and the temperature information which the temperature sensor 21 detects, the control section 24 calculates the quantity of hydrogen gas in the fuel tank 10, and outputs the result to residual quantity display 22 [a total of]. And residual quantity display 22 [a total of] which received the information on the quantity of hydrogen gas in the fuel tank 10 displays the residue of hydrogen gas in the fuel tank 10 according to the information.
(2. Rotation control of a damper) Rotation control of a damper is performed based on the gas pressure information which the hydrogen-gas-pressure sensor 20 detects.
[0017]If the pressure of hydrogen gas in the fuel tank which the hydrogen-gas-pressure sensor 20 detects becomes smaller than pressure Pd1 defined beforehand predetermined, the control section 24, Rotate the damper 15 by the drive of the damper drive motor 16, and the exhaust gas which comes out of the fuel cell body 12, and the combustion gas which comes out of the catalytic combustion device 13 are led to the circumference of the fuel tank 10, The burst size of hydrogen gas is increased by warming the hydrogen storing metal alloy with which it is filled up, On the other hand, if the pressure of hydrogen gas in the fuel tank which the hydrogen-gas-pressure sensor 20 detects becomes larger than pressure Pd2 defined beforehand predetermined, The damper 15 is rotated by the drive of the damper drive motor 16, and it discharges, without leading the exhaust gas which comes out of the fuel cell body 12, and the combustion gas which comes out of the catalytic combustion device 13 to the circumference of the fuel tank 10. Pd1 and Pd2 are set as the pressure which is stabilized to a fuel cell body and can send out hydrogen of sufficient quantity which power generation takes to it here, and the size relation of Pd1 and Pd2 is $Pd1<Pd2$. By the above control, where the hydrogen gas pressure in the fuel tank 10 is mostly maintained between Pd1-Pd2, this fuel cell will be operated.
(3. Failure diagnosis of the 1st and 2 opening and closing valve) Failure diagnosis of the 1st and 2 opening

and closing valve is performed using the gas pressure information which the hydrogen-gas-pressure sensor 20 detects.
[0018]Operation of the failure diagnosis of the 1st and 2 opening and closing valve which the control section 24 performs at the time of this fuel cell starting is explained based on the flow chart shown in drawing 3. At the time of this fuel cell starting, both the 1st and 2 opening and closing valves are closed. In this state, the control section 24 reads hydrogen-gas-pressure P which the hydrogen-gas-pressure sensor 20 detects (Step S10).
Pressure Pm1 beforehand set to read hydrogen-gas-pressure P is compared (Step S11), when P is one or more Pm, the 1st opening and closing valve fault light of the trouble indication device 23 is made to turn on, and processing (Step S12) is ended. Here, pressure Pm1 is set as the predetermined value slightly lower than pressure Pm2 used by processing of Step S16 mentioned later. the hydrogen gas pressure in the fuel tank [in / in pressure Pm2 / ordinary temperature] 10 and abbreviation — it is set as the equal value. . Therefore, at the time of this fuel cell starting, where the 1st opening and closing valve is closed, detected. When the pressure P of the opposite hand of the fuel tank 10 shows an one or more pressure Pm [which was set up a little lowness from the hydrogen gas pressure in the fuel tank 10] value to the 1st opening and closing valve 17 in the piping S, Since it will be said that "leak" has occurred in the 1st opening and closing valve 17, failure diagnosis of the 1st opening and closing valve 17 can be performed by the above-mentioned method.
[0019]On the other hand, the detection pressure power P at Step S11 when lower than setting-pressure Pm1, Processing progresses to Step S13, once opens the 1st opening and closing valve 17, and closes it again in 2 seconds (Step S14), and hydrogen-gas-pressure P which the hydrogen-gas-pressure sensor 20 detects from valve closing after 5 second passage is read (Step S15). Said pressure Pm2 beforehand set to read hydrogen-gas-pressure P is compared (Step S16), when P is two or less Pm, the 2nd opening and closing valve fault light of the trouble indication device 23 is made to turn on, and processing (Step S17) is ended. That is, by once opening the 1st opening and closing valve 17, with the 2nd opening and closing valve 18 closed, The pressure during double door valve closing in the piping S is raised to the pressure in the fuel tank 10, and until approximately equivalent, After closing the 1st opening and closing valve 17 again, when the value whose pressure P detected after 5 second passage is lower than pressure Pm2 set as the pressure in a fuel tank and the value of an abbreviated EQC is shown, Since it will be said that "leak" has occurred in the 2nd opening and closing valve 18, failure diagnosis of the 2nd opening and closing valve 18 can be performed by the above-mentioned method. Time when it is sufficient to raise the pressure during double door valve closing in the piping S to the pressure in the fuel tank 10 and until approximately equivalent made 2 seconds valve opening time of the 1st opening and closing valve 17.
It is because time will be made useless at ** and there is a possibility that the pressure during double door valve closing in the piping S may not be raised to the pressure in the fuel tank 10 and until approximately equivalent, by less than it in more than it.
When the failure "be leaked" to the 2nd opening and closing valve had occurred, sufficient time to produce the failure of pressure during double door valve closing in the piping S made 5 seconds time from valve closing of the 1st opening and closing valve 17 to pressure detection.
It is because there is a possibility that such the failure of pressure sufficient by more than it that time will be made useless and failure detection is possible for ** in less than it may not be obtained.

[0020]And at Step S16, when the detection pressure power P is two or more setting-pressure Pm, processing progresses to Step S18, makes O.K. lamp of the trouble indication device 23 turn on, and ends processing. Time (5 seconds) until it carries out after [the 1st opening and closing valve valve closing] pressure detection, the PCT characteristic of a hydrogen storing metal alloy, etc. are the valve opening time (2 seconds) of the 1st opening and closing valve used by this example, and a thing suitably changed according to the specification of a fuel cell, or the kind of hydrogen storing metal alloy.
[0021]Although the fuel tank where it fills up with the hydrogen storing metal alloy was used as a fuel gas supply source in this example, it is not limited to this and established natural gas, town gas, etc. may be used, for example.
[0022]
[Effect of the Invention]As mentioned above, according to the fuel cell concerning the invention according to claim 1, the failure determination of the 1st and 2 opening and closing valve provided in the fuel supply

piping between a fuel gas supply source and a fuel cell body between said opening and closing valves, It can carry out with the very simple composition of only having formed the pressure sensor which detects the pressure of the fuel gas which consists in said fuel supply piping, and has the effect that the pressure of the fuel gas of a fuel gas supply source is detectable by the sensor.

[0023]According to the fuel cell concerning the invention according to claim 2, the pressure sensor for the failure determination of the 1st and 2 opening and closing valve, Since the pressure sensor for performing control of the gas pressure of a fuel tank and detect residual quantity of fuel is made to serve a double purpose, in addition to the effect of the fuel cell according to claim 1, it has the effect referred to as that the cost cut by sharing of parts is obtained. In the state where the 1st and 2 opening and closing valve was closed for the failure diagnosis part at the time of starting according to the fuel cell concerning the invention according to claim 3, Since perform failure determination of the 1st opening and closing valve, and it continues from the detection value of a pressure sensor, the valve is closed after opening the 1st opening and closing valve, and failure diagnosis of the detection value of said pressure sensor after specified time elapse to the 2nd opening and closing valve is performed from valve closing, it has the same effect as the fuel cell according to claim 1 or 2.

[0024]After the failure diagnosis of the 1st and 2 opening and closing valve provided in the fuel gas charging line between a fuel gas supply source and a fuel cell body has closed the 1st and 2 opening and closing valve at the time of starting according to the fault diagnosis method of the fuel cell concerning the invention according to claim 4, A pressure sensor detects the pressure of the fuel gas which consists in piping in the meantime, and it continues, After opening the 1st opening and closing valve, the valve is closed, and it has the effect that it can carry out by the very simple method of carrying out by detecting the pressure of the fuel gas from valve closing with said pressure sensor after specified time elapse.

[Translation done.]

* NOTICES *

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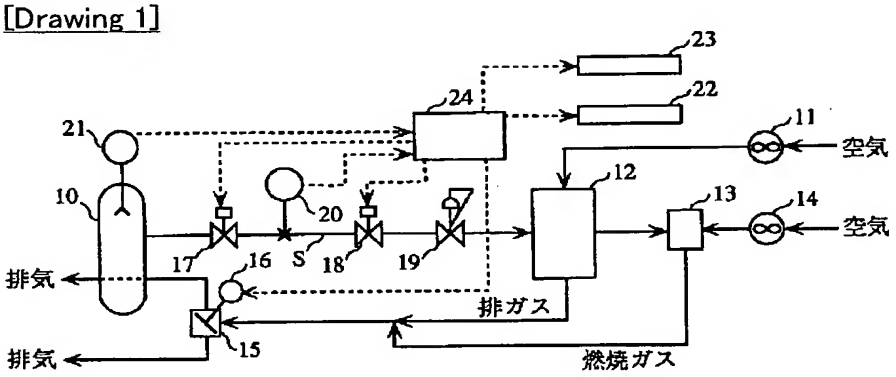
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.

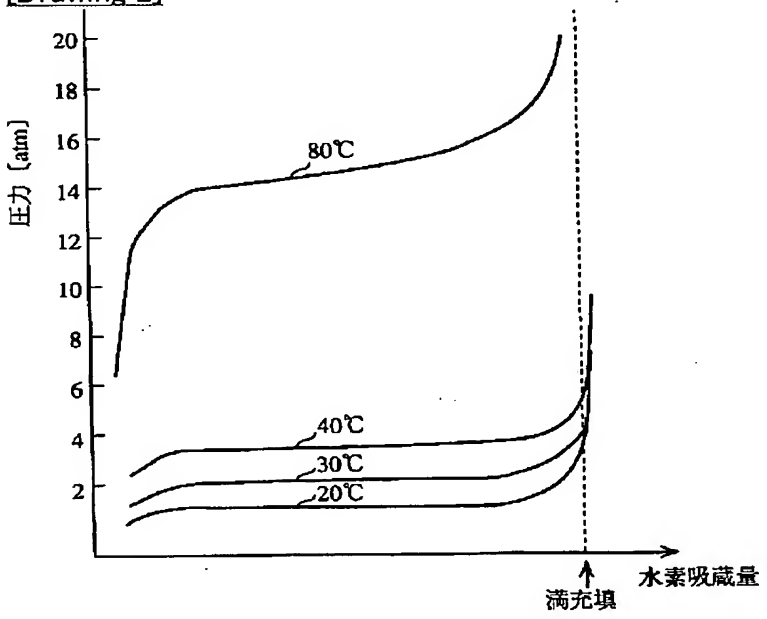
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

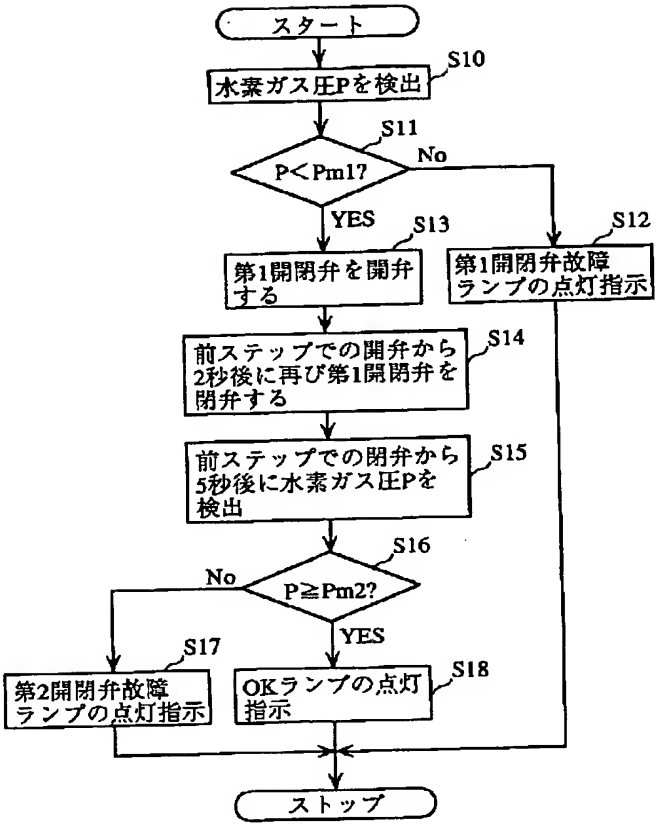
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1]A fuel cell comprising:
A fuel cell body which generates electricity by an electrochemical reaction in response to supply of fuel gas and oxidant gas.
A fuel gas charging line which leads fuel gas from a fuel gas supply source to said fuel cell body, The 1st opening and closing valve inserted in said fuel gas charging line and said fuel gas charging line are received at a flow of fuel gas, A pressure sensor which detects a pressure of fuel gas which is formed between the 2nd opening and closing valve inserted in the downstream from the 1st opening and closing valve, and the 1st opening and closing valve and the 2nd opening and closing valve, and consists in said fuel gas charging line in the meantime.

[Claim 2]The fuel cell according to claim 1, wherein said fuel gas supply source consists of fuel tanks and said pressure sensor makes a pressure sensor for performing control of gas pressure of said fuel tank, and detect residual quantity of fuel serve a double purpose.
[Claim 3]In the state where the valve was closed after having performed failure determination of the 1st opening and closing valve, continuing and opening the 1st opening and closing valve from a detection value of said pressure sensor in the state where said the 1st and 2 opening and closing valve was closed, at the time of starting, The fuel cell according to claim 1 or 2 characterized by having a failure diagnosis part which performs failure determination of the 2nd opening and closing valve from a detection value of said pressure sensor after specified time elapse from valve closing.
[Claim 4]For piping which supplies fuel gas to a fuel cell body from a fuel gas supply source characterized by comprising the following. A fuel cell which formed a pressure sensor which detects a pressure of fuel gas which inserts the 2nd opening and closing valve in the downstream, and consists in said piping in the meantime rather than the 1st opening and closing valve to a flow of the 1st opening and closing valve and fuel gas between the 1st opening and closing valve and the 2nd opening and closing valve.
A step which performs failure diagnosis of the 1st opening and closing valve from a detection value which said pressure sensor detects at the time of starting where the 1st and 2 opening and closing valve is closed.
A step which performs failure diagnosis of the 2nd opening and closing valve from a detection value which is closed after continuing and opening the 1st opening and closing valve, and said pressure sensor detects from valve closing after specified time elapse.